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Feasibility Impact Analysis Report
Weather Deck Runoff

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FEASIBILITY IMPACT ANALYSIS REPORT

DECK RUNOFF

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1.0 INTRODUCTION

The Feasibility Impact Analysis Report (FIAR) examines three of the seven considerations specified in the Uniform National Discharge Standards (UNDS) legislation for establishing performance standards for marine pollution control devices (MPCDs):

- Practicability of using the MPCD;
- Effect that installation or use of the MPCD would have on the operation or operational capability of the vessel; and
- Economic costs of the installation and use of the MPCD.

The Topside Management Plan (TMP) is the only MPCD option that passed the screening process as outlined in the *Marine Pollution Control Device Screen Guidance Document*. Section 2 addresses the economic costs associated with “the installation and use” of the TMP. The economic costs are incremental costs, which are the additional expenses that the Armed Forces would incur as a result of the implementation of UNDS regulatory requirements. For the purpose of this analysis, the incremental economic costs associated with the implementation of process-specific prevention activities are not included; however, available activity costs are analyzed to provide examples of how the TMP process could select activities for implementation.

This analysis is organized by process categories, as described in the Deck Runoff Characterization Analysis Report, that contribute to deck runoff (Navy, 2001a). For example, the aircraft launch and recovery equipment category includes the following processes: arresting gear, catapult operations, and jet blast deflectors. Sections 3.0 through 8.0 of the FIAR analyze the feasibility of implementing various management practices or other controls to achieve objectives (as defined in section 2.0) for each category. Examples of additional activities that could be performed, but are not analyzed in this report, may also be presented in each section. The list of prevention activities is not considered to be exhaustive. The specific criteria considered in this feasibility analysis are detailed in the *Feasibility Impact Analysis Guidance Document* (EPA and DoD, 2000b).

1.1 EXPLANATION OF DECK RUNOFF DISCHARGE

Multiple topside processes contribute constituents to deck runoff discharges. Some of these processes occur on most vessel classes (e.g., preservation of exterior topside surfaces) while other processes are limited to a few vessel classes (e.g., launching of fixed wing aircraft by aircraft carriers). Additionally, variables such as homeports and operations may also affect the type and amount of constituents that contribute to deck runoff. This results in a weak correlation of topside processes that generate deck runoff constituents, with vessel classes. Therefore, vessel groups for the deck runoff discharge were not created as described in the *Development of Vessel Groups and Selection of Representative Vessels for Feasibility and Environmental Effects Analyses Guidance* (EPA and DOD, 2000a).

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1.2 VESSELS THAT GENERATE DECK RUNOFF

Deck runoff was defined as the precipitation, washdowns, and seawater falling on the weather deck and exposed portions of a vessel and discharged overboard through deck openings (40 CFR 1700.4). A vessel intermittently produces deck runoff when water falls on or is applied to exposed surfaces, such as weather and flight decks, superstructure, bulkheads, and the hull above the waterline of a ship (e.g., freeboard and bulwark). Discharge constituents vary depending on the vessel's topside processes, and may include oil, grease, petroleum hydrocarbons, surfactants, cleaners, glycols, solvents, and particulates (e.g., soot, dirt, or metallic particles). All vessels generate deck runoff.¹

Topside processes were organized into the following six main categories (as identified in the deck runoff characterization report):

- Aircraft Launch and Recovery Equipment;
- Buoy Maintenance;
- Cleaning Activities/General Housekeeping;
- Deck Machinery and Weapons Lubrication;
- Exterior Topside Surface Preservation; and
- Vessel, Aircraft, and Vehicle Refueling and Lubrication.

These processes are described in sections 3.0 through 8.0.

¹ However, to facilitate the UNDS Phase II analysis, the Discharge Assessment Team (DAT) determined that water that falls on or is applied to exposed surfaces and accumulates in the lowest part of the vessel is classified as surface vessel bilgewater, and associated feasibility analyses are presented in the Surface Vessel Bilgewater Feasibility Impact Analysis Report (EPA and DOD, 1999).

2.0 TOPSIDE MANAGEMENT PLAN

The Topside Management Plan (TMP) is the only MPCD option that passed the screening process as outlined in the *Marine Pollution Control Device Screen Guidance Document*. Initially, a Fleet Topside Management Plan (FTMP) would be developed. The FTMP would address deck runoff constituent sources (i.e., categories) and list activities that could be implemented to prevent the discharge of those constituents, and specify documentation procedures. The fleet wide plan would be distributed to individual vessel program offices or commands. A Vessel Topside Management Plan (VTMP) would be a vessel specific plan that identifies deck runoff constituents and their sources, suggests practices and/or specifies measures to control those constituents, establishes objectives for each practice, and specifies documentation requirements. Every vessel would be required to be covered by and implement a VTMP. Individual vessels or the commands would review and tailor the fleet wide plan to address only the topside categories that contribute to the vessel's deck runoff. The activities listed in the FTMP would not be all-inclusive and would provide examples of how the vessel may achieve each objective. Vessels would be free to add new, innovative ideas to their VTMP. Similar, small vessels under the same command could share one TMP, as appropriate.

Responsible parties would review the VTMP to verify that it addresses all vessel specific topside categories that contribute to deck runoff. Furthermore, the TMP would be revised regularly to include new, more effective practices to control deck runoff constituents, as appropriate.

As explained in section 1.0, each category is comprised of one or more processes that contribute to deck runoff. Objectives were developed for each category to describe the desired potential controls and expected results. Objectives for each category are found in their respective sections (i.e., sections 3.0-8.0).

2.1 ECONOMIC COST ANALYSIS – INCREMENTAL COST APPROACH

Incremental costs are additional expenses that the Armed Forces would incur as a result of the implementation of UNDS regulatory requirements, and include initial and recurring costs. Most of the activities analyzed in the Deck Runoff FIAR are management practices that are currently in place on some or all Armed Forces vessels. For these activities, the incremental cost includes those resources necessary to develop and implement a TMP, which incorporates the existing management practices, as well as any additional activities that may be required to control deck runoff. The incremental cost for new activities would also include the costs to perform topside management practices or activities that would be required over and above current vessel operation. The cost to perform an activity may include: equipment, labor, and material costs. Unit costs provide an estimate for buying the equipment required to perform the activity. Unit costs are provided in lieu of total ownership costs due to the indeterminate nature of the factors required to implement each activity, which would have to be defined to form the basis for total ownership costs. Other vessel-specific incremental costs or personnel impacts that are TMP implementation dependent are not analyzed in this report. The cost analyses are not intended for preparation of budgets or determination of actual costs.

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2.1.1 Initial Cost

Initial cost may include acquisition, installation, and technical data development costs. For the TMP, this means establishing the management infrastructure and generating the military instructions to implement the TMP. For the examples of prevention activities, acquisition costs are provided by vendors, representatives, equipment model manufacturers, or equipment experts (with acquisition cost knowledge). Installation cost includes the cost of labor, materials, interface engineering, and oversight to install the equipment on one vessel, within the representative class. The Navy Alteration and Installation Team (AIT) estimated installation costs, unless referenced otherwise in the subsequent cost analysis, and technical drawing costs. The cost of training materials includes the cost to develop and implement a new module into existing training courses. Training module development costs are based on past Navy experience.

2.1.2 Recurring Costs

Recurring costs may include labor for operating and maintenance, consumable cost, and waste material disposal cost. The recurring costs are incurred on an annual basis. Some recurring costs were estimated using the ACEIT model. This model estimates the cost of the TMP over a 15-year lifecycle. This model assumes that acquisition and installation occur during year one of the 15-year lifecycle, and TMP implementation begins the following year. Therefore, the first year reflects initial costs only, and years two through 15 reflect recurring costs only. The ACEIT model presents costs expressed in 1999 dollars. ACEIT discounts the future costs (i.e., recurring cost) using discounted cash flow methodology to account for the time value of money. The cost analysis uses a discount rate of 3.2% that was based on the real interest rates on 15-year Treasury Notes and Bonds (OMB, 1992).

2.2 TOPSIDE MANAGEMENT PLAN COST IMPACTS

The cost of creating and implementing FTMPs for the Navy, U.S. Coast Guard, and U.S. Army vessels are addressed in this section. Table 2.1 at the end of this subsection summarizes the costs of implementing and maintaining a TMP for the Navy, U.S. Coast Guard, and U.S. Army.

2.2.1 Navy Cost Impacts

The Navy FTMP would be created by a headquarters-level command. This program would be a database containing the current, appropriate management activities for all Navy shipboard processes and would be distributed to all vessels. Each vessel or command (e.g., small boats) would enter the topside processes that it performs and the program would generate a suggested VTMP, including applicable activities. The majority of the expense for this program is the start-up cost to create the program. Based on previous, similar programs, the Navy estimates the initial cost to be approximately \$1,075,000 (Smith, 2002). This cost includes research, development, verification, distribution, and training for the program. Once each vessel has a working VTMP, the program will have reporting requirements and a feedback loop. Two representatives, one for the Pacific fleet and one for the Atlantic fleet, will manage this feedback loop. These representatives will be responsible for ensuring that new deck runoff activities are distributed to the fleet in a timely manner and maintaining the FTMP. The estimated cost for these personnel (labor and overhead) is \$320K per year (Smith, 2001). Personnel training for

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both the TMP and related activities is estimated to be approximately \$400K per year (Smith, 2002).

2.2.2 U.S. Coast Guard Cost Impacts

To research, develop, test, and implement a FTMP similar to the Navy database described in the above section, the U.S. Coast Guard estimates that the initial cost impact will be approximately \$500K (Volpe, 2001). This cost includes the establishment of a VTMP for each U.S. Coast Guard vessel. The development and implementation of a policy doctrine is estimated to be \$100K. Once the VTMP is in place, the feedback loop will have one member to provide fleet wide assistance at a cost (labor and overhead) of \$160K per year (Volpe, 2001). The U.S. Coast Guard feedback loop will be similar to the Navy program, with new deck runoff activities distributed fleet wide. Additional organizational training may be required. Training costs may include a training needs analysis (\$200K); a performance analysis (\$200K); and course materials (\$150K) (Volpe, 2001).

2.2.3 U.S. Army Cost Impacts

To research, develop, test, and implement a FTMP similar to the Navy database described in the above section, the U.S. Army estimates that the initial cost impact will be approximately \$100K (Arredondo, 2001a). This cost includes establishing a VTMP for each U.S. Army vessel. The feedback loop for the U.S. Army will be a collateral duty for a current program manager, with estimated annual costs (labor and overhead) estimated at ranging from \$25-50K (Arredondo, 2001a). Organizational training would be incorporated into existing Warrant Officer courses and costs are assumed to be negligible (Arredondo, 2001a).

Table 2.1 - Summary of FTMP Costs

Armed Force	Total Initial Cost (\$K)	Total Recurring Cost (\$K)	Incremental Cost (\$K)
Navy	1,075	8,023	9,098
U.S. Coast Guard	1,150	1,783	2,933
U.S. Army	100	557	657

3.0 CATEGORY: AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT (ALRE)

This category contributes oil, grease, solvent, and soot to deck runoff through the use of ALRE.

3.1 DESCRIPTION: AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT

The processes associated with this category are for:

- Arresting gear;
- Catapult operations; and
- Jet blast deflectors.

A description of these processes is presented below.

3.1.1 Arresting Gear

Arresting gear is used to recover aircraft on CV/CVN Class vessels. Arresting gear includes the following: sheave dampers, fairlead sheaves, barricade stanchions, retractable deck sheaves, wire supports, cross deck pendant (arresting gear wire), and purchase cable. The arresting gear wire is lubricated with grease, MIL-PRF-81322F, Grikote 31EP lubricating oil, dry-cleaning solvent MIL-PRF-680 type III, and anti-seize compound, A-A-59313 (Navy, 2001a). Any leakage or spills from the arresting gear are immediately cleaned up. However, residual amounts of these lubricants and solvents may become trapped in the rough deck surface and subsequently contribute to deck runoff both inside and outside 12 nm.

3.1.2 Catapult Operations

Catapults are used to launch aircraft from CV/CVN Class vessels. Catapults consist of a launching engine, control system, retraction engine, drainage system, and associated deck equipment. Because of their constant use and importance to fixed-wing operations, catapults require continuous maintenance, primarily lubrication of moving parts. Each catapult has a launching engine that is enclosed in the catapult trough, located immediately below the flight deck. Deck runoff entering the catapult's slotted openings flows into the drains that pass through duplex strainers and discharges overboard near the waterline. Strainer baskets fitted into the troughs collect debris from the runoff before it is discharged. In an effort to mitigate accumulation on the strainer basket, a rubber track slot-seal cover is installed when in port, during non-flight operations, between flight events, and during flight deck cleaning. Catapults are lubricated with grease, DOD-G-85733, and lubricating oil, SAE J1899, and cleaned with a solvent, MIL-PRF-680 Type III (Navy, 2001a). These substances have the potential to contribute to deck runoff. Any leakage or spills are immediately cleaned up. However, residual amounts of these lubricants and solvents may become trapped in the rough deck surface and subsequently contribute to deck runoff both inside and outside 12 nm.

3.1.3 Jet Blast Deflectors

Jet blast deflectors (JBD) are flush deck panels that are raised to divert jet engine exhaust from the flight deck. The equipment that raises and lowers the JBDs is lubricated with anti-seize

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compound, A-A-59313, grease, MIL-G-23549, dry cleaning solvent, and lubricating oil (no military specification) (Navy, 2001a). Jet exhaust soot also accumulates on the JBD. These substances have the potential to contribute to deck runoff. Any leakage or spills are immediately cleaned up. However, residual amounts of lubricants, soot, and related constituents may become trapped in the rough deck surface and subsequently contribute to deck runoff both inside and outside 12 nm.

3.2 PERFORMANCE OBJECTIVE: AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT

The performance objective for aircraft launch and recovery equipment is for the vessel's responsible party to prevent the discharge of oils, greases, solvents, soot, and other materials associated with ALRE that may negatively impact water quality.

3.3 ACTIVITIES: AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT

Examples of activities that could be performed to meet the performance objective of aircraft launch and recovery equipment include:

- Minimizing catapult test launches in port;
- Cleaning and stowing ALRE before transiting within 12 nm; and
- Using environmentally compliant lubricants for catapults or other equipment associated with ALRE.

Although other activities could be included in a vessel's TMP (e.g., using environmentally preferable cleaners, greases, and lubricants provided the product meets the military specification requirements of the equipment), this report analyzes only the activities listed above.

The feasibility and economic costs of these activities are presented below.

3.3.1 Minimizing Catapult Test Launches In Port

Catapult no-load testing is required after performing various maintenance actions (e.g., activities involving the low loss launch valves, hydraulic, and/or electrical control systems) to ensure system integrity and safe flight operations (Navy, 1999a). Naval Air Warfare Center Aircraft Division Lakehurst mandated the following procedures to minimize test launches in port: no-load shots in port should be limited to ten and lubrication shall be activated on the first shot only with the piston assembly in the battery position. After each no-load shot, the piston assembly should remain in the forward position for three to five minutes. Then the piston and shuttle assemblies should be maneuvered to the battery position for the subsequent shot. If additional no-load shots are required, the previously described process should be repeated with lubrication applied only during the first shot. This procedure was provided to commands via Naval message NAWCADLKE 200754Z NOV 97 (Navy, 1997). This activity reduces the number of catapult test launches, therefore reducing the discharge of oil, grease, and soot to deck runoff.

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3.3.1.1 Personnel Impact

Minimizing catapult test launches in port is currently an accepted practice onboard Armed Forces vessels that conduct catapult operations. Because this practice is currently in place, additional impacts on personnel are not expected.

3.3.1.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

3.3.1.3 Cost Analysis

Minimizing catapult test launches in port is currently an accepted practice on Armed Forces vessels. The only incremental cost associated with this activity is incorporating it into the TMP.

3.3.2 Cleaning and Stowing ALRE Before Transiting within 12 nm

When CV/CVNs plan to be in port for an extended period of time, the arresting gear is disconnected and stowed below decks (Navy, 2001a). When the vessel is going to transit within 12 nm, the cross deck pendant is disconnected from the purchase cable and laid alongside the flight deck. The loose purchase cable is then retracted into the sheave damper spaces (Alexander, 2001a). This activity prevents the grease, oil, and anti-seize compounds from contributing to deck runoff. Also, before the CV/CVNs return to port, the catapult trough drain strainer baskets are cleaned and the catapult track slot-seals are installed, which closes off the catapult track slots (Navy, 2001a). This cover protects the catapult from damage while not in use and prevents water from entering the trough, therefore preventing the introduction of additional constituents to deck runoff. The barricade stanchion is cleaned upon returning to port. This cleaning prevents barricade stanchion constituents from contributing to deck runoff. The feasibility and cost of this activity are presented below.

3.3.2.1 Personnel Impact

On Armed Forces vessels, ALRE is currently cleaned and stowed before transiting within 12 nm. Because this practice is currently in place, additional impacts on personnel are not expected.

3.3.2.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

3.3.2.3 Cost Analysis

Cleaning and stowing ALRE before returning to port is currently an accepted practice on Armed Forces vessels. The only incremental cost associated with this activity is incorporating it into the TMP.

3.3.3 Use an Environmentally Compliant Lubricant for Catapults or other Equipment Associated with ALRE

The Navy is currently implementing an engineering change to replace the currently used catapult lubricant with an environmentally compliant catapult lubricant (as defined in ECP1-CAT-0013). Environmentally compliant, as defined for this activity, means the product meets the

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requirements set forth in Annex I of Marine Pollution (MARPOL), the Act to Prevent Pollution from Ships (APPS), and the Clean Water Act (Opet, 2000). This engineering change is being implemented on all CV/CVN Class vessels (Weeks, 2001). The environmentally compliant catapult lubricant has been tested and evaluated both ashore at Naval Air Warfare Center Aircraft Division Lakehurst and at sea, on CVN 70 (Opet, 2000). All CV/CVN Class vessels will perform this activity when the elimination of the non-environmentally compliant lubricant is complete. Using environmentally compliant catapult lubricant will reduce the amount of oil residue deposited in the catapult trough by 96 %; thereby reducing the amount of oil contributing to deck runoff (Opet, 2000). The feasibility and cost of this activity are presented below.

3.3.3.1 Personnel Impact

The environmentally compliant catapult lubricant is used in the same manner as the lubricant currently in place. Therefore, there is no personnel impact.

3.3.3.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

3.3.3.3 Cost Analysis

The incremental cost for the new lubricant is \$338 per 55 gallons. This cost is based on the difference between the cost of the non-environmentally compliant lubricant (i.e., \$175 per 55 gallons) and the cost of the environmentally compliant catapult lubricant (i.e., \$513 per 55 gallons) (Alexander, 2001a; Alexander, 2001b).

4.0 CATEGORY: BUOY MAINTENANCE

This category contributes rust, paint chips, paint drips, cleaning compounds, sediment, and biofouling material to deck runoff due to maintenance performed underway on buoys.

4.1 DESCRIPTION: BUOY MAINTENANCE

The only process included in this category is the maintenance and preservation of buoys. A description of this process is presented below.

4.1.1 Maintenance and Preservation of Buoys

The U.S. Coast Guard is the only branch of the Armed Forces that retrieves, maintains, and resets navigational buoys. Buoy maintenance includes cleaning, inspection, repairing, and preservation. Buoys, which are used for navigational and weather observation purposes, are maintained both inside and outside 12 nm, with the majority of buoys inside 12 nm. Buoys, along with their sinkers and anchor chains, are raised from their position in the water and hauled on deck using cranes and cross-deck winches. Once on the vessel's deck, the buoys, sinker, and chain are cleaned, inspected, repaired, preserved, and subsequently returned to their position. U.S. Coast Guard buoy tenders take buoys in need of major repair to shore for restoration. Buoys are cleaned using a scraper and seawater supplied by a high-pressure washer. Cleaning compounds (e.g., Simple GreenTM) are used to clean the buoy's solar panel, but do not contribute to deck runoff because they are utilized in a manner (e.g., applied and removed by cloth) that does not allow significant contribution to deck runoff.

During the cleaning process, loose rust, paint, and marine biofouling (including marine growth and mammal/bird excrement) are removed from the buoys. Approximately 99 % of the material removed during cleaning is comprised of sediment and marine biofouling, while less than 1 % is rust and paint chips (Navy, 2001a). When a buoy-tending vessel conducts maintenance and preservation on a buoy that is going to be reset in the same place that it was hauled in from, the vessel stays as close as it safely can to the haul-in/deploy location. If the buoy is going to be transported to a buoy overhaul facility, an overhauled or new buoy will be deployed in its place. Except when operational requirements prohibit (i.e., vessel traffic, shoal water), loose biofouling material is immediately washed off of the buoy, chain, and sinker. This process consists of using a fire hose to remove loose biofouling material from the buoy, chain, and sinker, while they are being lifted out of the water. This process, which continues until the buoy is ready to be secured, removes loose material including mud and organisms, directly into the water where the buoy was deployed. The buoy is then chained down so the new buoy can be deployed resulting in only one loose buoy at a time. Once the deployment of the new buoy is complete, the crew turns their attention to cleaning the remaining biofouling materials from the chained down buoy as described in the previous paragraph. If another buoy in the vicinity is to be hauled and deployed, the crew may postpone cleaning the previously hauled buoy as they prepare for the next haul-in. Buoy tending vessel operators depend on this flexibility to be able to efficiently tend to the buoys in their area of responsibility. For example, if the next buoy to be hauled is only 500 yards up the river or bay, it may be more efficient to haul and deploy the next buoy while the weather and vessel traffic are favorable to operations. This may result in a delay of the final biofouling material cleaning of the previously hauled buoys. However, as long as the biofouling material is discharged in the same "ecological area" (as defined in the deck runoff environmental effects

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analysis report (EEAR)), the potential to transport non-indigenous species (NIS) is eliminated (Volpe, 2002a).

4.2 PERFORMANCE OBJECTIVE: BUOY MAINTENANCE

The performance objective for buoy maintenance is for the vessel's responsible party to prevent the discharge of rust, paint chips, paint drips, cleaning compounds, and other materials associated with buoy maintenance that may negatively impact water quality. An additional objective of buoy maintenance is to prevent the transport of non-indigenous invasive species with fouling material and sediment released during buoy maintenance operations.

4.3 ACTIVITIES: BUOY MAINTENANCE

Examples of activities that could be performed to meet the performance objective of buoy maintenance include:

- Using high pressure washers;
- Conducting only minor buoy repairs underway; and
- Discharging biofouling material and sediment from where the buoy was pulled

The feasibility analyses for these activities are presented below.

4.3.1 Using High-Pressure Washers

This activity involves using a focused, high-pressure washer with a 3,000-psi water stream to remove marine biofouling during buoy cleaning evolutions (Navy, 2001a). Before pressure washers were available, marine biofouling was removed using only a scraper. This method was less effective at removing some types of biofouling and resulted in loss of paint that was still intact, because the scraper damaged the paint surface while removing the surface debris. Proper use of high-pressure spray, however, allows removal to be limited to only unwanted biofouling and failed paint, minimizing the discharge of paint into the environment. The force used by a high-pressure washer to remove biofouling and failed paint can be controlled by slowly moving the pressure wand closer to the surface. This allows the paint condition to be observed while removing the biofouling, reducing unnecessary discharge of paint. Therefore, use of the high-pressure washer reduces the contribution of paint chips to deck runoff. It will still be necessary to use a scraper to efficiently remove bulk biofouling material (that can exceed one foot thickness) or any tightly adherent biofouling that can not be effectively removed by the high-pressure washer. All U.S. Coast Guard buoy tenders use a high-pressure washer to perform buoy cleaning when appropriate (Volpe, 2001a). The feasibility and economic cost of this activity are presented below.

4.3.1.1 Personnel Impact

Using a high-pressure washer to clean buoys is currently an accepted practice onboard Armed Forces vessels conducting buoy maintenance. Because this practice is currently in place, additional impacts on personnel are not expected.

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4.3.1.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

4.3.1.3 Cost Analysis

Using a high-pressure washer to clean buoys is currently an accepted practice onboard Armed Forces vessels conducting buoy maintenance. The only incremental cost associated with this activity is incorporating it into the TMP.

4.3.2 Conducting Only Minor Buoy Repairs Underway

This activity consists of performing only minor paint removal, various repairs (e.g., structural welding), and touch-up preservation while underway. Minimizing both paint removal and painting during underway buoy maintenance reduces the amount of paint chips and drips on the deck where they could potentially contribute to deck runoff. Buoys that require major painting or repair are transferred to shore where major maintenance is performed. All Armed Forces vessels conducting buoy maintenance perform this activity. The feasibility and economic costs of this activity are presented below.

4.3.2.1 Personnel Impact

This activity is currently an accepted practice onboard Armed Forces vessels conducting buoy maintenance. Because this practice is currently in place, additional impacts on personnel are not expected.

4.3.2.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

4.3.2.3 Cost Analysis

Minimizing underway buoy paint repairs is an accepted practice on Armed Forces vessels that maintain buoys. The only incremental cost associated with this activity is incorporating it into the TMP.

4.3.3 Discharging Biofouling Material and Sediment from where the Buoy was Pulled

During routine buoy cleaning, biofouling organisms and sediment are rinsed from the buoys and deposited on the deck. This activity involves discharging this material in the same ecological area as where the buoy is stationed. Discharging in the same ecological area could reduce the risk of transporting non-indigenous species to sensitive areas. All Armed Forces vessels conducting buoy maintenance perform this activity. The feasibility and economic cost of this activity are presented below.

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4.3.3.1 Personnel Impact

Discharging biofouling material and sediment from where the buoy was pulled is currently an accepted practice onboard Armed Forces vessels conducting buoy maintenance. Because this practice is currently in place, additional impacts on personnel are not expected.

4.3.3.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

4.3.3.3 Cost Analysis

Discharging biofouling material and sediment from where the buoy was pulled is currently an accepted practice onboard Armed Forces vessels conducting buoy maintenance. The only incremental cost associated with this activity is incorporating it into the TMP.

5.0 CATEGORY: CLEANING ACTIVITIES/GENERAL HOUSEKEEPING

This category contributes cleaning compounds, hydraulic fluid, oil, grease, dirt, salt, soot, and other materials to deck runoff resulting from cleaning activities/general housekeeping.

5.1 DESCRIPTION: CLEANING ACTIVITIES/GENERAL HOUSEKEEPING

The processes included in the cleaning activities/general housekeeping category include:

- Aircraft washdowns;
- Electronic intelligence/navigation systems maintenance;
- Exterior topside surfaces washdowns; and
- Equipment and vehicle washdowns.

Descriptions of these processes are presented below.

5.1.1 Aircraft Washdowns

Aircraft washdowns are performed to clean the airframe (i.e., exterior surfaces) and engines of aircraft, both fixed wing and rotary wing, on the flight deck. Aircraft washdowns remove dirt, soot, salt, hydraulic fluid (MIL-PRF-83282D), lubricating oil (MIL-PRF-23699F), and grease (MIL-PRF-23827C and MIL-PRF-81322F). Washwater or residual constituents from these operations can remain trapped in the rough deck surface and subsequently contribute to deck runoff. Aircraft washdowns are generally performed on a set schedule (e.g., daily, every seven days, after each flight, etc.). Aircraft washdowns are a vital component of maintaining safe and effective aircraft. Washdowns minimize corrosion and maintain the aerodynamic integrity of aircraft surfaces.

U.S. Coast Guard vessels, including those with rotary wing aircraft, operate both inside and outside 12 nm. U.S. Coast Guard rotary wing aircraft are washed daily when underway (U.S. Coast Guard, 2001a; U.S. Coast Guard, 2001b). Therefore, washdowns of U.S. Coast Guard aircraft may occur within 12 nm. However, the vast majority of washdowns occur outside 12 nm, because Coast Guard vessels typically do not have an aircraft embarked when the vessels are operating within 12 nm. During washdowns, freshwater is mixed with VCI-415 aircraft cleaning compound and used to clean the aircraft (U.S. Coast Guard, 2000). The aircraft is wetted down and rinsed using less than 500 gallons of freshwater. The washwater/aircraft-cleaning compound drains directly overboard.

All U.S. Coast Guard and most Navy vessels that are expected to accommodate one to two rotary wing aircraft are designed with a flight deck that can only accommodate one of the aircraft at a time. If the vessel carries a second aircraft, one aircraft must remain in the hangar while the other aircraft is on the flight deck. The aircraft on the flight deck is positioned above a device called a “TALON” grid. This is the position that the aircraft must takeoff and land from. Additionally, any maintenance not conducted in the hangar is conducted in this position. The TALON grid is an approximately 10-16 foot diameter circular flush deck grid that the aircraft’s hold-down device hooks into. The grid has a cavity beneath it that drains directly overboard. The grids are always greater in diameter than the aircraft’s fuselage. Therefore, any constituents

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that may drip from the aircraft's fuselage, forward landing gear, or result from fuselage/engine washing or refueling activities, drip/drain directly into the TALON grid cavity. Washwater from areas of the aircraft (nose and tail sections) that are not over the TALON grid falls onto the deck. However, these sections do not contribute constituents of significance because of their enclosed and limited machinery. Due to the vessel motion experienced by these smaller vessels, and the proximity of the aircraft to the deck drains, aircraft washwater quickly drains overboard. For example, the WHEC 378 foot cutter has a beam (width) of only 38 feet. With the aircraft centered over the TALON grid, the aircraft washwater needs to travel less than 19 feet to reach the deck's edge, and less than that to reach a drain. On these smaller vessels, aircraft wash water (which may contain detergents or other constituents) on deck combined with vessel motion creates an unsafe work environment for personnel. The crew typically rinses any aircraft wash water left on deck at the conclusion of the aircraft wash to the deck drains or deck edge (Volpe, 2002b). Because most of the washwater and constituents drain through the TALON grid, there is less residual trapped in the rough deck surface that could subsequently contribute to deck runoff on U.S. Coast Guard and Navy vessels that are to accommodate one to two rotary wing aircraft.

A complete freshwater washdown of Navy rotary wing aircraft is performed every seven days (Navy, 2001a). The washdown solution consists of approximately eight ounces of aircraft cleaning compound, MIL-C-85570C Type II or MIL-C-87937D, for every one gallon of freshwater. The aircraft is wetted down and rinsed using freshwater. The washwater/aircraft cleaning compound mixture drains directly overboard. Navy rotary wing aircraft are washed outside 12 nm (Navy, 2001a). Before and after rotary wing aircraft washdowns, all aircraft fittings are greased (Navy, 2001a).

The difference between Navy and U.S. Coast Guard rotary wing aircraft washdown schedules is due to their different operating profiles and vessel sizes. Navy vessels typically have different operating missions than U.S. Coast Guard vessels. Furthermore, U.S. Coast Guard vessels that carry rotary wing aircraft are typically much smaller than Navy vessels that carry rotary wing aircraft. Because U.S. Coast Guard vessels are smaller than Navy air-capable vessels and often lack of a hangar, the aircraft are exposed to more sea spray than on larger vessels. To prevent premature corrosion of vital aircraft components, the aircraft on U.S. Coast Guard vessels are washed more frequently than on Navy vessels.

Freshwater washdowns of fixed wing aircraft are performed every 14 days on the CV/CVN vessel class (Navy, 2001a). For fixed wing aircraft assigned to other vessels, such as the LHD 1, freshwater washdowns are performed every seven days (Surgeon, 2001). Aircraft cleaning compound, MIL-C-85570C Type II, is used for washdowns. The water and soap solution falling on the deck is continuously vacuumed during the washdown (Navy, 2001a). All washdown water is subsequently discharged overboard. Because all aircraft depart the vessel before it is within 12 nm, fixed wing aircraft are not washed onboard within 12 nm (Navy, 2001a). Table 5.1 presents aircraft cleaning compounds used on various vessel classes.

Table 5.1 - Aircraft Cleaning Compounds Used on Various Vessel Classes

Vessel Class	Aircraft Type	Aircraft Washdown Cleaning Compounds
AOE 6	Rotary Wing	MIL-C-87937D
CV/CVN	F-14, F/A-18, S-3, SH-60	MIL-C-81302 Type II
LHD 1	Rotary Wing	MIL-C-85570C Type II
WMEC/WHEC/WAGB	Rotary Wing	VCI-415

Engine washdowns are performed on aircraft to remove dirt, salt, hydraulic fluid, and grease from engines. The frequency of these washdowns depends on the operational engine hours. Gas path MIL-C-85704C Type I or IIA cleaner is mixed with water and used to clean the engines. The washwater/aircraft cleaning compound mixture is removed from the flight deck using a vacuum, then discharged overboard. On Navy vessels, aircraft depart the vessel before it is within 12 nm of the U.S. coast. Therefore, Navy aircraft engines are not washed onboard within 12 nm (Navy, 2001a). In addition, appendix L of Operational Naval Instruction (OPNAVINST) 5090 states that wastewater from aircraft engine washdowns can only be disposed overboard outside 12 nm, and that aircraft engine washwater produced within 12 nm must be containerized for shore disposal (Navy, 1999b). U.S. Coast Guard rotary wing aircraft engines are not washed within 12 nm (U.S. Coast Guard, 2001a).

5.1.2 Electronic Intelligence/Navigation Systems Maintenance

Armed Forces vessels have a variety of electronic intelligence/navigation systems. This equipment normally consists of antennas and radar (both surface search and navigational). The surface search and navigational radars are cleaned using fresh water and a cleaning compound (Simple GreenTM). Cleaning the radars has the potential to contribute cleaning compounds to deck runoff both inside and outside 12 nm (Navy, 2001a).

5.1.3 Equipment and Vehicle Washdowns

Vessels can carry and transport a variety of different equipment and vehicles, ranging from aircraft towing tractors to tanks. These vehicles can be used as part of the vessel's normal operations, (e.g., aircraft towing tractors) or the vehicles can be cargo (e.g., tanks). This equipment is washed frequently to prevent the accumulation of salt from sea spray. Dirt, oil, grease, salt, and cleaning compounds may be washed off and contribute to deck runoff. Most equipment and vehicle washdowns are performed on Navy and U.S. Coast Guard vessels outside 12 nm; however, some residue remains trapped in the rough deck surface and contributes to deck runoff inside 12 nm (Navy, 2001a).

On U.S. Army open deck vessels, vehicles are washed frequently with freshwater to prevent accumulation of salt from sea spray. Equipment and vehicle washdowns can occur both inside and outside 12 nm. War fighting ground equipment/cargo is always taken to a land-based wash rack for washdowns. Any petroleum product that might fall from the war fighting ground equipment/cargo to the deck is immediately cleaned up. However, residual petroleum products may become trapped in the rough deck surface and have the potential to contribute to deck runoff (Legge, 2002).

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5.1.4 Exterior Topside Surface Washdowns

Exterior topside surface (ETS) washdowns are performed to clean constituents deposited by the environment or crew/personnel activities. Constituents may include: cleaning compounds, fuel, hydraulic fluid, oil, grease, dirt, paint chips, rust, salt, soot, and other materials [‘Human waste’ was deleted and ‘other materials’ was added to avoid confusion. The CHAR presents the explanation of human waste generation (from migrants)]. During ETS washdowns, the ETS may be scrubbed using detergent, brushes, and steam cleaners. On aircraft carrier and amphibious assault vessels, one-person rider-type scrubbers (i.e., Tennant Scrubbers) are used for flight decks (Navy, 2001a). Typically, large amounts of freshwater or seawater, minor amounts of cleaning compounds, and residue deposited on the deck flow overboard during ETS washdowns (Navy, 2001a). Although cleaning compounds and residues may vary by vessel class, as presented in Table 5.2, the ETS washdown process is similar for all vessels. Depending on the vessel and its mission, ETS washdowns may occur inside or outside 12 nm, or pierside. The activities identified for ETS washdown apply to all vessel classes unless noted.

Table 5.2 - Examples of Cleaning Compounds Used on Various Vessel Exterior Topside Surfaces

Vessel Class	Exterior Topside Surface Washdown Cleaning Compound	Notes
AOE 6	General Purpose Detergent, MIL-D-16791G	
CV/CVN	Flight Deck Cleaning Compound, B&B 88	Tennant flight deck scrubber used for general clean-up
DDG 51	General Purpose Detergent, MIL-D-16791G	--
LHD 1	Flight Deck Cleaning Compound, B&B 88	Tennant flight deck scrubber used for general clean-up
MCM 1	Simple Green TM	--
WAGB	Simple Green TM	--
WLI	Simple Green TM	--
WLB	Simple Green TM	--
WLM 175	Simple Green TM	--
WPB 110	Simple Green TM and Brite Crème	--
> 55 FT	Simple Green TM and Zip Wax Car Wash TM	--

Onboard U.S. Coast Guard vessels, Simple GreenTM is the detergent used most frequently to conduct exterior topside surface washdowns. Table 5.3 presents U.S. Coast Guard vessel washdown procedures (Keel, 2001).

Table 5.3 - Various U.S. Coast Guard Vessels Exterior Topside Surface Washdown Procedures

Vessel Type	Location	Cleaning Frequency	Amount of Simple GreenTM Used
WAGB, WHEC, WMEC 270, and WMEC 210	Inside 12 nm	Complete washdown after every patrol (2-6 per) year	5 gallons
WLB and WLM	Inside 12 nm	Once per week, top to bottom washdown	5 gallons
WLI, WLIC, WLR, WTGB, and WYTL	Inside 12 nm	Once per week, top to bottom washdown	1 gallon
WPB	Inside 12 nm	Approximately 3-4 washdowns per month	2 gallons
≤ 55 ft	Inside 12 nm	Daily washdowns	1/2 gallon

Onboard U.S. Army vessels, exterior topside surface washdowns are conducted after completion of transportation operations (i.e., embarking/disembarking ground equipment/cargo). The frequency of such practices are dependent on the operational scenario (i.e., ship is carrying war fighting ground equipment/cargo), but are always performed if the ship has taken green water (ocean water that washes over the decks in heavy seas) over the deck. It is common practice for a ship to conduct a freshwater washdown of the topside area prior to entering port, particularly if the ship has encountered heavy weather. Almost all exterior topside surface washdowns occur inside 12 nm. Any petroleum product that might fall from the war fighting ground equipment/cargo to the deck is immediately cleaned up. However, residual petroleum products may become trapped in the rough deck surface and have the potential to contribute to deck runoff. Whereas exterior topside surface washdowns almost always occur inside 12 nm, war fighting ground equipment/cargo is always taken off the ship to a land-based wash rack for washdown (Legge, 2002).

5.2 PERFORMANCE OBJECTIVE: CLEANING ACTIVITIES/GENERAL HOUSEKEEPING

The performance objective for cleaning activities/general housekeeping is for the vessel's responsible party to prevent the discharge of cleaning compounds, hydraulic fluids, oils, fuels, greases, dirt, salts, soot, and other materials associated with cleaning activities/general housekeeping that may negatively impact water quality.

5.3 ACTIVITIES: CLEANING ACTIVITIES/GENERAL HOUSEKEEPING

Examples of activities that could be performed to meet the performance objective of cleaning activities/general housekeeping include:

- Minimize cleaning for aircraft, ETSs, equipment, and vehicles within 12 nm;
- Using a vacuum to remove water from aircraft washdowns conducted outside 12 nm;
- Using a flight deck scrubber; and
- Cleaning tie down fixtures with vacuums;

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The feasibility and economic costs for these activities are presented below.

Although other activities could be included in a vessel's TMP (e.g., dividing the weather deck into zones to facilitate cleaning and using environmentally preferable cleaners, greases, and lubricants provided the product meets the military specification requirements of the equipment), this report analyzes only the activities listed above.

5.3.1 Minimize Cleaning for Aircraft, Exterior Topside Surfaces (ETS), Equipment, and Vehicles within 12 nm

Aircraft Washdowns

Fixed and rotary wing aircraft are washed both inside and outside 12 nm, depending on the patrol areas of the vessels to which they are assigned. When the patrol for aircraft capable vessels occurs beyond 12 nm, the aircraft are generally washed outside 12 nm. For example, fixed wing aircraft, found only on Navy vessels, are always washed outside 12 nm. Rotary wing aircraft can be washed inside or outside 12 nm. In general, on Navy vessels, rotary wing aircraft operations occur outside 12 nm; therefore, these aircraft are washed outside 12 nm. On U.S. Coast Guard vessels, rotary wing aircraft may be washed inside or outside 12 nm, with the majority of aircraft washes occurring outside 12 nm. If the aircraft were washed outside 12 nm, the washwater, grease, detergents and other constituents flowing overboard would not contribute to mass loadings of these constituents inside 12 nm. However, residual of constituents trapped in the rough deck surface could subsequently contribute to deck runoff inside 12 nm. U.S. Coast Guard aircraft do not conduct operations from moored vessels. To conduct this activity, vessels could announce to their crews when they are transiting inside 12 nm, to give crewmembers the opportunity to conduct cleaning operations before the vessel transits within 12 nm. Note, for this activity, vessels would not expressly transit outside 12 nm for the sole purpose of conducting aircraft washdowns. Table 5.4 presents the estimated percentages for the location of U.S. Coast Guard rotary wing aircraft washdowns on U.S. Coast Guard aircraft capable vessels (Navy, 2001c). The U.S. Coast Guard conducts approximately one rotary wing washdown inside 12 nm for every ten washdowns conducted outside 12 nm (Navy, 2001c).

Table 5.4 - U.S. Coast Guard Vessel Class Rotary Wing Aircraft Washdowns

Vessel Class	Washdowns Inside 12 nm	Washdowns Outside 12 nm
WAGB 399	0%	100%
WHEC 378	8%	92%
WMEC 270	7%	93%
WMEC 210	7%	93%

Exterior Topside Surface Washdowns

ETS washdowns are conducted both inside and outside 12 nm, depending on the patrol area of the vessel. If ETSs were washed outside 12 nm, the mass loadings of constituents present on the deck that contribute to deck runoff inside 12 nm would be reduced. Vessels perform ETS washdowns regardless of their location when conditions or requirements necessitate a washdown. However, if a vessel is operating outside 12 nm as part of a specific patrol, the vessel may conduct the ETS washdown outside 12 nm. For this activity, vessels would not

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specifically transit outside 12 nm to conduct ETS washdowns. Because of the enormous number of missions and operational areas of the over 7,000 Armed Forces vessels, the amount this activity (i.e., washdowns outside 12 nm) would be performed on various vessel classes will not be quantified.

Equipment and Vehicle Washdowns

Conducting equipment and vehicle washdowns outside 12 nm would reduce constituents, such as grease and oil from the deck that could contribute to deck runoff within 12 nm. Crews perform equipment and vehicle washdowns, regardless of their vessel's location, when washdowns are necessary based on conditions or requirements. For this activity, vessels would not specifically transit outside 12 nm to conduct equipment and vehicle washdowns. However, if a vessel is operating outside 12 nm as part of a specific patrol, the vessel may conduct equipment and vehicle washdowns outside 12 nm. One method the U.S. Army uses to minimize washdowns inside 12 nm is conducting equipment and vehicle washdowns on a land-based wash rack. The equipment is removed from the vessels and washed on a rack, where all the constituents are collected for proper disposal. Minimizing cleaning of equipment and vehicles while on the vessel is currently in place for the Army's ground support equipment and vehicle transport processes. The feasibility and cost of this activity are presented below.

5.3.1.1 Personnel Impact

Minimizing cleaning operations inside 12 nm for aircraft, ETSs, equipment, and vehicles, is an accepted practice onboard Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

5.3.1.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

5.3.1.3 Cost Analysis

Minimizing cleanings inside 12 nm for aircraft, ETSs, equipment, and vehicles is an accepted practice on Armed Forces vessels. The only incremental cost associated with this activity is incorporating it into the TMP.

5.3.2 Using a Vacuum to Remove Aircraft Washwater Generated Outside 12 nm

This activity entails using a wet/dry vacuum to remove the water generated during aircraft washdowns conducted outside 12 nm. A crewmember would use the vacuum to recover the cleaning compound/water mixture before it becomes trapped in the rough deck surface where it could later contribute to deck runoff (Navy, 2001a). No tanks are currently available to hold this washwater. Therefore, the washwater would be discharged overboard outside 12 nm. For vessels operating outside 12 nm, the constituents of deck runoff (e.g., dirt, oil, and grease) are removed from the deck before the vessel transits within 12 nm. This activity is similar to section 5.3.4, cleaning decks with vacuums.

Small aircraft-capable vessels (e.g., WMEC) that only carry one or two rotary wing aircraft have small flight decks. On these vessels, the aircraft washwater that is not trapped in the rough deck surface immediately runs to, or can be washed down, a deck drain that discharges directly

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overboard. Therefore, using vacuum equipment to collect the aircraft washwater on small aircraft capable vessels may not be feasible.

5.3.2.1 Personnel Impact

Using a vacuum to remove aircraft washwater outside 12 nm is an accepted practice onboard some Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

5.3.2.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

5.3.2.3 Cost Analysis

The unit cost of the equipment required to perform this activity will be evaluated in this analysis. The unit costs for vacuums and related equipment to remove discharge water from aircraft washdowns are presented in Table 5.5 for each vessel not currently equipped with a vacuum (Grainger, 2001). For vessels currently equipped with a vacuum, the only incremental cost associated with this activity is incorporating it into the TMP.

Table 5.5 - Unit Cost of Equipment for Using Vacuums to Remove Discharge Water

Equipment	Unit Price
Dayton, Plastic Wet/Dry Vacuum 6 gallon, 4.5 HP	\$124
Dayton, Stainless Steel Wet/Dry Vacuum 15 gallon, 3.0 HP	\$436
Dayton, Plastic Wet/Dry Vacuum 25 gallon, 2.0 HP	\$206
Dayton, Stainless Steel Wet/Dry Vacuum 20 gallon, 4.0 HP	\$629
Vacuum Filter Cartridge	\$12
Vacuum Hose, 8ft	\$21
Vacuum Hose, Crushproof, 6 ft	\$17
Vacuum Hose, Crushproof, 12 ft	\$41
Vacuum Hose, Crushproof, 25 ft	\$75
Vacuum Bags, from 5 gal to 25 gal	\$22-32

5.3.3 Using a Flight Deck Scrubber

A flight deck scrubber is a ground washer that uses cleaning compounds, water, and rigid brush bristles to clean the flight deck. On CV/CVN and LHD 1 Class vessels, a Tennant 550 Riding Power Scrubber is used to remove oil, grease, dirt, and other debris found on the flight deck. No tanks are currently available to hold this washwater. As a result, the washwater is discharged overboard, outside 12 nm (Navy, 2001a). For smaller, air-capable vessels, such as the DDG 51 and AOE 6 Class vessels, smaller, walk-behind scrubbers are available. Operators walk behind these scrubbers; the scrubbers temporarily collect the water and debris in a holding tank. Using

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flight deck scrubbers reduces the constituents that may become trapped in the rough deck surface and subsequently contribute to deck runoff when the vessel transits within 12 nm. For vessels operating outside 12 nm, using a vacuum reduces or removes many deck runoff constituents from the deck before the vessel transits within 12 nm. The rider scrubbers are currently used on all large flight deck vessels such as CV/CVN and LHD 1 Class vessels. Some smaller, air-capable vessels use walk-behind scrubbers. However, data regarding how many vessels use the walk-behind scrubbers is unavailable. The feasibility and cost analysis of both the in-place rider scrubbers and the prospective walk-behind scrubbers are presented below.

Small aircraft capable vessels only carry one or two small rotary wing aircraft. Washwater produced by manual scrubbing methods immediately runs to, or can be washed down, deck drains that discharge directly overboard. Therefore, flight deck scrubbers may not be practical for small aircraft capable vessels. The residuals of constituents trapped in the rough deck surface could subsequently contribute to deck runoff inside 12 nm.

5.3.3.1 Personnel Impact

This activity is currently performed on vessels that can accommodate more than two aircraft on their flight deck. Because this practice is currently in place, additional impacts on personnel are not expected.

On smaller, air-capable vessels, a walk-behind scrubber requires one crewmember to operate. However, as explained above this activity may not be feasible for smaller, aircraft capable vessels and will not be explored further in this analysis.

5.3.3.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

5.3.3.3 Cost Analysis

The unit costs for both rider type and walk-behind scrubbers will be evaluated in this analysis. For vessels currently equipped with a flight deck scrubber, the only incremental cost associated with this activity is incorporating it into the TMP. The unit costs for flight deck scrubbers are presented in Table 5.6 (Tennant, 2001).

Table 5.6 - Unit Cost of Flight Deck Scrubbers

Scrubber Type	Unit Price from Government Services Administration Schedule
550 Riding Power Scrubber, 50 inch Cleaning Path, Gasoline	\$53,168
550 Riding Power Scrubber, 50 inch Cleaning Path, LP Gas	\$54,612
550 Riding Power Scrubber, 50 inch Cleaning Path, Diesel	\$55,835
550 Riding Power Scrubber, 50 inch Cleaning Path, Battery	\$56,279
5700 Cylindrical Scrubber, Walk Behind 28 inch Cleaning Path, Battery	\$8,694
5700 Cylindrical Scrubber, Walk Behind 32 inch Cleaning Path, Battery	\$9,030
5700 Cylindrical Scrubber, Walk Behind 36 inch Cleaning Path, Battery	\$9,790

5.3.4 Cleaning Deck Tie Down Fixtures with Vacuums

Armed Forces crewmembers currently use pneumatic wet/dry vacuum cleaners to remove liquids and other debris from recessed tie down fixtures at sea and in port. Recessed tie down fixtures are fastening points for straps and chains used to secure aircraft and other equipment on a vessel's deck. For this activity, the vacuumed liquid and/or debris are collected and disposed of immediately after the vacuuming by dumping it overboard when the vessel is steaming at sea beyond 12 nm whenever feasible. In port disposal would be into a sanitary sewer or by some other environmentally acceptable means. Performing these activities are expected to produce a localized environmental benefit because the vacuumed liquid and debris do not contribute to deck runoff.

This activity is similar to section 5.3.2, which describes using a vacuum to remove aircraft washwater generated outside 12 nm. The feasibility and cost of this activity are presented below.

5.3.4.1 Personnel Impact

Cleaning tie down fixtures with vacuums is an accepted practice onboard some Armed Forces vessels. There will be personnel impacts on vessels that do not currently use pneumatic wet/dry vacuum cleaners to remove liquids and other debris out of recessed tie down fixtures.

5.3.4.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

5.3.4.3 Cost Analysis

The unit cost of the equipment required to perform this activity is presented in this analysis for vessels that do not clean tie down fixtures with vacuums; adding a system would be an incremental cost. For vessels that currently clean decks with vacuums, the only incremental cost

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associated with this activity is incorporating it into the TMP. See Table 5.5 for the unit cost of vacuums and related equipment.

6.0 CATEGORY: DECK MACHINERY AND WEAPONS LUBRICATION

This category contributes cleaning compounds, grease, hydraulic fluid, solvents, and oil to deck runoff resulting from deck machinery and weapons lubrication.

6.1 DESCRIPTION: DECK MACHINERY AND WEAPONS LUBRICATION

The processes included in deck machinery and weapons lubrication are:

- Aircraft elevators;
- Buoy handling systems;
- Mine handling systems;
- Recovery, assist, securing, and traversing systems;
- Ship's boats/launching systems;
- Stores handling systems; and
- Weapons systems.

Descriptions of these processes are presented below.

6.1.1 Aircraft Elevators

Aircraft elevators are found on a variety of large aircraft-capable vessels, including CV/CVN and LHD Class vessels. The elevators are used to move aircraft from the hangar deck to the flight deck. Elevator cables, rails, and stanchions are lubricated by hand using DOD-G-24508A, MIL-G-23549, MIL-G-18458B, and MIL-G-24139A grease (Navy, 2001a). These elevator components are exposed to the weather where the rain and wind causes these lubricants to fall to the deck and subsequently contribute to deck runoff both inside and outside 12 nm.

6.1.2 Buoy Handling Systems

Buoy handling systems are found on U.S. Coast Guard vessels that conduct buoy maintenance. Buoy maintenance includes cleaning, inspection, repairing, and preservation. Buoys, which are used for navigational and weather observation purposes, are maintained both within and beyond 12 nm, with the majority of buoys inside 12 nm. Buoys, along with their sinkers and anchor chains, are raised from their position in the water and hauled on deck using cranes and cross-deck winches. The wire rope on the cranes and cross-deck winches is lubricated with MIL-G-18458B grease. MIL-H-17672D hydraulic fluid is used in the cranes and cross-deck winches. Through normal buoy operations, grease and hydraulic fluid are deposited on the deck (e.g., leaks) and contribute to deck runoff. Although the majority of this grease and hydraulic fluid is immediately cleaned up, some remains trapped in the rough deck surface and may contribute to deck runoff both inside and outside 12 nm.

6.1.3 Mine Handling Systems

Mine-searching vessels are designed to locate and safely detonate mines. One example of a mine-searching vessel is the MCM 1 Class. Each MCM 1 Class vessel has three outrigger

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booms that tow mine-detonating devices. MIL-G-24139A grease is applied to the articulating pins on the outrigger booms (Navy, 2001a). When the lubricated pins are exposed to wind and rainfall, the grease may fall onto the deck and subsequently contribute to deck runoff. MCM 1 vessels are equipped with cranes to operate mine-detecting equipment. The cranes on MCM 1 vessels use hydraulic fluid (MIL-H-17672D) and lubricating oil (MIL-PRF-2105E) (Navy, 2001a). Over time, these hydraulic hoses have the potential to wear and cause leaks. Although the leaks of grease and hydraulic fluid are immediately cleaned up, the potential exists for residual amounts to remain on the deck and contribute to deck runoff both inside and outside 12 nm.

6.1.4 Recovery, Assist, Securing, and Traversing Systems

The recovery, assist, securing, and traversing (RAST) system is used to assist helicopters when landing on smaller vessels during rough weather. The RAST system is found on smaller flight deck capable vessels, such as the DD 963, FFG 7, and CG 47, (Navy, 2001a). During a RAST landing evolution, the helicopter lowers a messenger line to the ship. The vessel fastens a cable to that line, which the helicopter crew fastens to their helicopter. The vessel then winches the helicopter to the deck using a motor embedded in the flight deck. The cables and track for the motor require lubrication using MIL-PRF-81322F grease (Navy, 2001a). Although grease deposits are immediately cleaned up, the potential exists for residual amounts of grease to remain on the deck and contribute to deck runoff both inside and outside 12 nm.

6.1.5 Ship's Boats/Launching Systems

Numerous vessel classes carry small boats that are used for various activities including lifeboats, law enforcement, supply transfers, and personnel transfers. The engines of these ship's boats are started periodically to ensure they run correctly. Depending on the vessel's mission and procedure specified by the vessel's Commanding Officer, the boat engines are operated daily to weekly while positioned on the deck of the vessel. This operation deposits a mixture of gasoline (or diesel) and motor oil onto the deck of the vessel that could potentially contribute to deck runoff both inside and outside 12 nm. The boats are launched using either a crane or davit system. The cranes or davits are connected to the boat by wire rope (Navy, 2001a). The wire rope is lubricated using various military standard greases and cleaned using various standard cleaners. Table 6.1 lists various vessel types along with the lubricants and functional fluids of their small boat launching systems. Exposure to the rain and wind causes these lubricants to fall to the deck and contribute to deck runoff both inside and outside 12 nm.

Table 6.1 – Examples of Material Used in Boat Launching Systems

Vessel Class	Rope Lubricator	Wire Rope Cleaner	Hydraulic Fluid
AOE 6	MIL-G-18458B	MIL-DTL-5624T (JP-5)	None
DDG 51	MIL-G-23549	MIL-PRF-680 Type III	None
MCM 1	None	Simple Green™	None
WLM 175	MIL-G-18458B	None	MIL-H-17672D
WPB 110	MIL-G-18458B	MIL-PRF-680 Type III	NAPA Dextron III

*Nylon rope is used on MCM 1 Class vessel's boat launching systems therefore lubricants are not required.

6.1.6 Stores Handling Systems

The stores handling system is used to transfer supplies from ship-to-ship or shore-to-ship. Although ship-to-ship transfer is performed outside 12 nm, the equipment used for this process has the potential to contribute to deck runoff when the vessel is within 12 nm. This equipment includes kingposts, winch engines, wire rope, cable drums with sheaves, and control systems and is lubricated with either MIL-G-24139A grease or MIL-G-23549 grease (Navy, 2001a). Because the kingpost assembly, wire ropes, and cable drums are exposed to the weather, extreme temperature or heavy rainfall can cause the grease to fall to the deck and contribute to deck runoff both inside and outside 12 nm. One example of a stores handling vessel class is the AOE 6. The AOE 6 Class vessel has four winch engines that contain engine oil and hydraulic fluid. Although spills are immediately cleaned up, residual engine oil and hydraulic fluid have the potential to remain on the deck and contribute to deck runoff both inside and outside 12 nm.

6.1.7 Weapons Systems

Most vessel classes have a fixed weapons system that is exposed to the weather. Table 6.2 lists various vessel classes and their weapons systems. These weapons are maintained through cleaning, lubrication, and preservation. Either MIL-L-63460D or MIL-G-21164D is used to lubricate the weapons system (Navy, 2001a). MIL-PRF-680 Type III degreasing solvent is used to clean some weapons systems. Some weapons systems have protective covers to minimize exposure to the weather. Some of these covers are not weather-tight and the system is exposed to wind and water. This exposure may cause grease to be deposited on the deck and contribute to deck runoff both inside and outside 12 nm.

Table 6.2 – Examples of Various Weapons Systems

Vessel Class	Weapons System	Lubricant	Cleaner
AOE 6	MK 38 25 MM, Rapid Fire Fixed Mount (2)	MIL-L-63460D	MIL-D-16791G
	Close In Weapons System (CIWS) (2)	MIL-L-63460D	MIL-D-16791G
	M2HP .50 Caliber Machine Gun (4)	MIL-L-63460D	MIL-D-16791G
DDG 51	MK 45 5"/54 Caliber Light Weight Gun (1)	MIL-G-21164D	MIL-PRF-680 Type III
	MK 41 Vertical Launch Missile System (2)	NONE	MIL-PRF-680 Type III
	MK 32 MOD 14 Triple Barreled Torpedo Launcher (2)	NONE	MIL-PRF-680 Type III
	CIWS (2)	MIL-L-63460D	Peel Away 7
	M2HP .50 Caliber Machine Gun (2)	MIL-L-63460D	MIL-PRF-680 Type III
MCM 1	M2HP .50 Caliber Machine Gun (2)	MIL-L-63460D	Simple Green™
WPB 110	MK 38 25 MM, Rapid Fire Fixed Mount (2)	MIL-L-63460D	Simple Green™
	M2HP .50 Caliber Machine Gun (2)	MIL-L-63460D	Simple Green™

6.2 PERFORMANCE OBJECTIVE: DECK MACHINERY AND WEAPONS LUBRICATION

The performance objective for deck machinery and weapons lubrication is for the vessel's responsible party to prevent the discharge of cleaning compounds, greases, hydraulic fluids, solvents, oils, fuels, and other materials associated with deck machinery and weapons lubrication that may negatively impact water quality.

6.3 ACTIVITIES: DECK MACHINERY AND WEAPONS LUBRICATION

Examples of activities that could be performed to meet the performance objective of deck machinery and weapons lubrication include:

- Using a wire rope lubricator;
- Using covers or protective devices such as;
 - Chafing guards at friction points on exposed hydraulic hoses;
 - Extensions on winch engine oil drains;
 - Fitted covers on cranes and mounts/weapons;
 - Sample fittings on winch engines; and
 - Tarps used during equipment maintenance.

Although other activities could be included in a vessel's TMP (e.g., using nylon rope on light duty cranes, modifying practice of daily outboard checks, and using environmentally preferable

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cleaners, greases, and lubricants provided the product meets the military specification requirements of the equipment), this report analyzes only the activities listed above.

The feasibility and economic cost of these activities are discussed below.

6.3.1 Using a Wire Rope Lubricator

Currently, some vessels use rags to apply and remove grease from cables. This process results in the application of excessive grease that then has the potential to fall to the deck. Although grease deposits are immediately cleaned up, some grease can become trapped in the rough deck surface and contribute to deck runoff. This activity consists of using a wire rope lubricator to remove and apply grease to cables (Kirkpatrick, 1999). The wire rope lubricator applies grease under pressure to drive out old, moisture-contaminated grease from internal and external wire strands and scrapes off this used grease using a groove cleaner (Kirkpatrick, 1999). The used grease is deposited in a bucket located under the scraper, where it can be containerized for proper disposal (Kirkpatrick, 1999). Using a wire rope lubricator reduces the amount of excessive grease because the grease is primarily applied to the internal sections of the wire rope, not the exterior. Reducing the amount of surface grease reduces the amount of grease that has the potential to fall off onto the deck and subsequently contribute to deck runoff. This activity is intended for the mine handling system, ship's boats/launching system, and stores handling system processes. Most Armed Forces vessels use a wire rope lubricator.

6.3.1.1 Personnel Impact

Using a wire rope lubricator is an accepted practice on most Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

6.3.1.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

6.3.1.3 Cost Analysis

The unit cost for wire rope lubricators is presented in Table 6.3 for vessels that do not currently have wire rope lubricators (Warren, 2001). For vessels that currently have wire rope lubricators, the only incremental cost associated with this activity is incorporating it into the TMP.

Table 6.3 - Unit Cost of Wire Rope Lubricator Equipment

Equipment	Unit Cost
1-5/8 inch Wire Rope Lubricator, with a 5-gallon portable cart grease unit	\$3,525
Seal kit, required for every 1,000 feet of wire rope	\$335
Groove kit, required for every 1,000 feet of wire rope	\$125

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6.3.2 Using Covers or Protective Devices

Grease applied to deck machinery and weapons may contribute to deck runoff. Using waterproof covers or protective devices prevents grease and oil from falling or being blown or washed to the deck, therefore reducing the amount of grease and oil that may contribute to deck runoff. The following is a summary of five activities that use covers or protective devices.

Installing Chafing Guards at Friction Points on Exposed Hydraulic Hoses

This activity will prevent chafing of hydraulic hoses therefore minimizing leaks from these hoses. This activity is intended for use both in the ship's boats/launching systems and the mine handling systems processes. Chafing guards are made of nylon and hard rubber and are installed directly onto the hoses. By absorbing the friction caused by normal vessel movement, the chafing guards reduce the wear and tear on the hoses. Only hoses that have a risk of chafing require guards; that number is dependent on the arrangement of hoses for each specific ship. Most Armed Forces vessels use chafing guards at friction points on exposed hydraulic hoses.

Installing Extensions on Winch Engine Oil Drains

This activity will improve collection of used winch engine oil. These extensions, made from steel tubing, enable crewmembers to drain the dirty oil directly into the container, facilitating more efficient oil collection. Currently, the oil draining is not connected directly to the container. This exposed flow of oil sometimes results in spills. A drip pan is used to collect the spilled oil. Although spills outside the drip pan are immediately cleaned up, some oil remains trapped in the rough deck surface and contributes to deck runoff. This activity reduces the contribution of oil from the winch engine oil drain to deck runoff. This activity is intended for use in the stores handling systems process.

Installing Fitted Covers on Cranes and Mounts/Weapons

This activity consists of covering both cranes and weapons systems with form fitting, waterproof covers with fasteners (zippered or snap) on the sides. Currently, some vessels have covers, but most are not form fitting (Navy, 2001a). Using fitted covers when the equipment is not in use would reduce exposure to rain and seawater, therefore reducing the contribution of grease and hydraulic fluid to deck runoff. The expected service life of a cover is five years. Most vessels of the Armed Forces use fitted covers on cranes and mounts/weapons to protect them from environmental conditions. Covers would not be required where installing them would inhibit the rapid deployment of equipment or weapons. Additionally, covers would not be required if they would cause the equipment or weapons to rust due to moisture that would be trapped inside the cover. This activity is intended for use on both the ship's boats/launching system and the weapons system processes.

Installing Sample Fittings on Winch Engines

This activity facilitates winch engine oil sampling. Currently, the hydraulic line must be opened and reconnected to take a hydraulic fluid sample. This method often causes minor hydraulic fluid spills and increases the risk of leaks due to improper reassembly. Although these spills are immediately cleaned up, some oil remains trapped in the rough deck surface and can potentially

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contribute to deck runoff. The installation of an integrated sampling line, consisting of a hydraulic screen ball valve and cap, would enable the user to collect samples without compromising the integrity of the hydraulic line. This activity would reduce the contribution of oil to deck runoff and is intended for use in the stores handling systems process.

Using Tarps During Equipment Maintenance

This activity enables personnel working on systems that contain grease and oil (e.g., boat cranes and davits) to collect constituents that may fall to the deck during routine maintenance. The tarp prevents the grease and oil from falling to the deck where they may contribute to deck runoff both inside and outside 12 nm. After the maintenance is complete, the tarp is stored below decks. The tarps are reused until their condition warrants disposal. Worn out tarps are disposed of at a shoreside Hazardous Minimization Center (Navy, 1999b).

6.3.2.1 Personnel Impact

Using covers or protective devices is an accepted practice on all Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

6.3.2.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

6.3.2.3 Cost Analysis

All Armed Forces vessels perform some activities that use covers or protective devices for the processes described above. For vessels that currently perform activities to prevent grease from falling to the deck, the only incremental cost is incorporating that activity into the TMP. The following paragraphs summarize the incremental costs of using covers or protective devices.

Installing Chafing Guards on Exposed Hydraulic Hoses

Installing chaffing guards is currently an accepted practice on Armed Forces vessels. The only incremental cost associated with this activity is incorporating it into the TMP.

Install Extensions on Winch Engine Oil Drains

The Navy's Alteration and Installation Team (AIT) estimates that installing (e.g., labor, material, and contract supervision) the winch engine oil drain will cost approximately \$2,150 per vessel (Navy, 2001b). The Navy estimates that the development of technical drawings will cost approximately \$250 per vessel. The total unit cost for the installation of winch engine oil drains is \$2,400 as presented in Table 6.4.

Table 6.4 - Unit Costs for Winch Engine Oil Drain Extension

Item	Unit Cost
Technical Documentation	\$250
Installation Cost	\$2,150
Total	\$2,400

Installing Fitted Covers on Cranes and Mounts/Weapons

The unit cost of a fitted cover is \$3/square foot (Cox, 2001). For vessels currently using fitted covers, the only incremental cost associated with this activity is incorporating it into the TMP.

Installing Sample Fittings on Winch Engines

The Navy's Alteration and Installation Team (AIT) estimates that installing (e.g., labor, material, and contract supervision) sample fittings on winch engines will cost approximately \$1,060 per vessel (Navy, 2001b). The Navy estimates that the development of technical drawings will cost approximately \$500 per vessel (Navy, 2001b). The total unit cost for the installation of sample fittings on winch engines is \$1,560 as presented in Table 6.5.

Table 6.5 - Unit Costs for Sample Fittings on Winch Engines

Item	Unit Cost
Technical Documentation	\$500
Installation Cost	\$1,060
Total	\$1,560

Using Tarps During Equipment Maintenance

Tarps are inexpensive and currently used on Armed Forces vessels. The usage rates for tarps would be difficult to quantify; however, costs are expected to be negligible. For vessels currently using tarps during equipment maintenance, the only incremental cost associated with this activity is incorporating it into the TMP.

7.0 CATEGORY: EXTERIOR TOPSIDE SURFACE PRESERVATION

This category contributes rust (and other corrosion by-products), cleaning compounds, non-skid material fragments, and paint chips to deck runoff resulting from the preservation of exterior topside surfaces.

7.1 DESCRIPTION: EXTERIOR TOPSIDE SURFACE PRESERVATION

This topside process includes restoration of coated (painted or non-skid covered) surfaces. A description of this process is presented below.

7.1.1 Restoration of Painted Surfaces

All vessels are subject to some type of preservation of exterior topside surfaces while afloat, with the exception of boats that are hauled out of water after their daily use. This process consists of both removing existing paint and rust from the deck/superstructure and reapplying paint to preserve the vessel's surface. Generally, paint is removed using needle guns, disc sanders, sandpaper, wire brushes, and grinders, and applied using brushes, rollers, and sprayers. Major and minor maintenance and preservation are performed in drydock or in port; however, only minor touch-ups are conducted beyond 12 nm (Navy, 2001a). Paint chips and dust are collected, and deck surfaces are cleaned on all Armed Forces vessels after surface preparation and before painting. Surface cleaning includes sweeping and mopping the deck. On some vessels, paint chips and dust are collected using drop cloths and/or vacuum assisted equipment, including vacuum assisted needle guns, sanders, and grinders. Following paint removal on Navy vessels, the paint chips are properly packaged and held until they can be turned in to the Hazardous Minimization Center for proper disposal ashore (Navy, 1999b). Also on Navy vessels, every painting activity is recorded on a shop verification form and signed off by a responsible supervisor (Navy, 1996). When painting, drop cloths are used to collect paint spray and drips. Paint drips are usually spot-cleaned with a rag and solvent. The solvent is immediately wiped up and does not contribute to deck runoff. Rust (and other corrosion by-products), cleaning compounds, paint chips, and non-skid material fragments are the constituents of concern in deck runoff resulting from the preservation of exterior surfaces.

7.2 PERFORMANCE OBJECTIVE: EXTERIOR TOPSIDE SURFACE PRESERVATION

The performance objective for exterior topside surface preservation is for the vessel's responsible party to prevent the discharge of rust (and other corrosion by-products), cleaning compounds, paint chips, non-skid material fragments and other materials associated with exterior topside surface preservation that may negatively impact water quality.

7.3 ACTIVITIES: EXTERIOR TOPSIDE SURFACES PRESERVATION

Examples of activities that could be performed to meet the performance objective of exterior topside surface preservation include:

- Performing general housekeeping, such as sweeping and/or mopping, on the affected areas;

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- Using drop cloths when removing and applying paint; and
- Using vacuum-assisted needle guns, sanders, and grinders.

The feasibility analyses for these activities are presented below.

7.3.1 Performing General Housekeeping on the Affected Areas

During general housekeeping, the decks are swept using brooms and lightly swabbed using brushes, mops, and small amounts of freshwater, with or without detergent, to remove paint chips. There is no attempt to collect the washwater remaining on the deck following general housekeeping. The washwater from the mops is wrung out into the buckets and discharged into the vessel's wastewater system. Naval Ship's Technical Manual (NSTM) Chapter 631, the Preservation of Ships in Service, requires vessels to perform general housekeeping while conducting paint removal and application. Any paint chips that are collected are held for proper disposal at a shoreside Hazardous Minimization Center (Navy, 1999b). Every ship in the Armed Forces has the capability to sweep and perform general housekeeping following painting activities.

7.3.1.1 Personnel Impact

Performing general housekeeping on the affected areas is an accepted practice onboard all Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

7.3.1.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

7.3.1.3 Cost Analysis

The quantity of equipment used for general housekeeping is required for total ownership cost calculations. The usage rates for products such as brooms, mops and rags, is difficult to quantify and costs are expected to be negligible. Therefore, the cost of this activity will not be evaluated in this analysis. The only incremental cost associated with this activity is incorporating it into the TMP.

7.3.2 Using Drop Cloths When Removing and Applying Paint

This activity is a management practice that involves crewmembers using drop cloths when removing and applying paint to reduce the amount of paint chips and drips deposited on the deck. The drop cloth collects paint chips and over spray before they are deposited on the deck and contribute to deck runoff. Drop cloths are reused until their condition warrants disposal. All paint chips and unusable drop cloths are collected and held for proper disposal at a shoreside Hazardous Minimization Center (Navy, 1999b). All Armed Forces vessels currently use drop cloths for paint removal and application. The feasibility and economic costs of this activity are presented below.

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7.3.2.1 Personnel Impact

Using drop cloths when conducting painting activities is an accepted practice onboard all Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

7.3.2.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

7.3.2.3 Cost Analysis

Drop cloths are inexpensive and currently used on vessels of the Armed Forces. The usage rates for drop cloths are difficult to quantify and costs are expected to be negligible. Therefore, the cost of using drop cloths will not be evaluated in this analysis. The only incremental cost associated with this activity is incorporating it into the TMP.

7.3.3 Using Vacuum-Assisted Needle Guns, Sanders, and Grinders

Some paint removal equipment (e.g., needle guns, sanders, and grinders) has built in vacuums that collect paint chips and dust as they are generated, thereby reducing the amount of constituents that could be deposited on the deck and subsequently contribute to deck runoff. A vacuum-assisted system consists of a central vacuum unit with the individual tools attached. Various sizes of vacuum-assisted systems are available, from single tool to ten tool units. The vacuum bags can be either disposable or reusable (Clayton Associates, 2001). The chips, dust, and disposable bags are removed from the vacuum for proper disposal at a shoreside Hazardous Minimization Center (Navy, 1999b). For U.S. Coast Guard vessels, paint chips, dust, and disposable bags are disposed of in accordance with Commandant Instruction (COMDTINST) M16478.1B, the Hazardous Waste Management Manual. For U.S. Army vessels, paint chips, dust, and disposable bags are disposed of in accordance with Technical Manual 43-0139, Painting Instructions for Army Materiel. The feasibility and economic costs of this activity are presented below.

7.3.3.1 Personnel Impact

Using vacuum-assisted tools while conducting painting activities is an accepted practice onboard some Armed Forces vessels. On vessels that currently use vacuum-assisted tools, additional personnel impacts are not expected. There will be personnel impacts on vessels that do not currently use vacuum-assisted tools, including training. However, the impacts are assumed to be negligible because all vessels perform exterior topside preservation and the non-assisted tools are similar in fundamental design and operation to the vacuum-assisted tools.

7.3.3.2 Other/Unique Characteristics

Every vessel in the Armed Forces has the ability to use vacuum-assisted tools during painting activities. Some vessels have the resources and space to maintain the equipment onboard, while smaller vessels must use equipment maintained shoreside.

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7.3.3.3 Cost Analysis

The unit cost of equipment required to perform this activity is presented in this analysis for vessels that do not own a vacuum-assisted tool system; adding a system would be an incremental cost. For vessels that currently use a vacuum-assisted tool system, the only incremental cost associated with this activity is incorporating it into the TMP. The unit cost of a vacuum-assisted tool system is presented in Table 7.1 below (Clayton Associates, 2001).

Table 7.1 - Unit Cost of a Vacuum-Assisted Tool System

Equipment	Unit Price
HEPA Filtered Heavy Duty Vacuum	\$2,558
Extra Motor Brushes	\$0
Tool Caddy	\$237
Two DA Orbital Sanders w/Allen Wrench	\$524
Two 6" MS Backup Pads for MK2S	\$50
Two Hose Assemblies for DA Sander	\$217
Two Rotary Sander/Grinders w/Open End Wrench	\$1,050
Two 8" MS Backup Pads for M1500S	\$81
Two Hose Assemblies for Rotary Sander/Grinder	\$217
6mil Polyliner (25/pk)	\$44
"Y" Adapter (to operate 2 tools)	\$78
2 Filter Bag Packs (5/pk)	\$163
Prefilter (3/pk)	\$133
DustMaster Technical Manual	\$0
VHS Training Video Tape	\$0
6" Pierce Plate for MK2S Sander	\$49
8" Pierce Plate for M1500S Sander	\$58
Total	\$5,460

8.0 CATEGORY: VESSEL, AIRCRAFT, AND VEHICLE REFUELING AND LUBRICATION

This category contributes anti-freeze, fuel, hydraulic fluid, oil, and grease to deck runoff resulting from vessel, aircraft, and vehicle refueling and lubrication.

8.1 DESCRIPTION: VESSEL, AIRCRAFT, AND VEHICLE REFUELING AND LUBRICATION

The processes included in the vessel, aircraft, and vehicle refueling and lubrication category are:

- Aircraft refueling;
- Fixed wing aircraft maintenance and operations;
- Fuel transfer systems;
- Ground support equipment; and
- Rotary wing aircraft maintenance and operations.

Descriptions of these processes are presented below.

8.1.1 Aircraft Refueling

Aircraft refueling consists of transferring fuel from the ship's tanks to aircraft on the flight deck, though a series of pipes, hoses, and connections. Depending on the vessel's mission operational area, aircraft may be refueled either inside or outside 12 nm. Aircraft are fueled with JP-5 (MIL-DTL-5624T) aircraft fuel. This fuel may be spilled by either aircraft fuel tank venting or malfunctioning equipment. These spills are immediately cleaned, but the potential exists for JP-5 residue to remain on the deck and contribute to deck runoff both inside and outside 12 nm.

8.1.2 Fixed Wing Aircraft Maintenance and Operations

Fixed wing operations are performed on larger, aircraft capable vessels such as the CV/CVN and the LHD 1 classes. Fixed wing aircraft can be on board the vessel both inside and outside 12 nm, with the majority of fixed wing operations occurring outside 12 nm. Prior to and upon completion of aircraft washdowns (see section 5.0 cleaning activities/general housekeeping), the fixed wing aircraft are lubricated with MIL-PRF-81322F grease. This grease prevents water entry into critical mechanical fittings and linkages. However, this recurring maintenance forces old grease out of the mechanical fittings and linkages, and a portion of this grease possibly falls to the deck. Fixed wing aircraft also contain large amounts of hydraulic fluid, MIL-PRF-83282D, which may leak (Navy, 2001a). Although the majority of this grease and hydraulic fluid is immediately cleaned up, some remains trapped in the rough deck surface and may subsequently contribute to deck runoff both inside and outside 12 nm.

8.1.3 Fuel Transfer Systems

The fuel transfer system is used when a ship receives fuel at sea or in port. This fuel may include MOGAS, F-76 (MIL-F-16884J), and JP-5 (MIL-DTL-5624T). Underway re-fueling is

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primarily done from the oiler vessel classes, such as the AOE 6 Class, to all other ship classes and performed outside 12 nm. The AOE 6 Class has five topside fuel transfer stations, and each station has winches and wire rope that are used to connect the hose between ships. The winches and wire rope are lubricated with MIL-G-24139A grease (Navy, 2001a). Rainfall can cause the grease on the winches and wire ropes to contribute to deck runoff. In port refueling can be performed from either a permanent pierside fueling station, a floating fuel barge, or a pierside refueling truck. In all cases, the fuel is pumped to the ship through a topside fuel receiving station. Fueling also occurs from a vessel to its small boats. This transfer is normally performed by pouring fuel from a container into a tank on the small boat. During all fueling operations, drip pans are placed below the fueling stations. These pans are designed to collect spillage. However, some spillage may occur outside of the pan when the hose is connected and disconnected from the fueling station, or when pouring the fuel into tanks for small boats. Also, hose failures may occur during fueling operations. These spills are immediately cleaned up. However some fuel may remain trapped in the rough deck surface and contribute to deck runoff, both inside and outside 12 nm.

8.1.4 Ground Support Equipment

Ground support equipment is found on larger vessel classes, such as the AOE 6, CV/CVN and LHD 1. This equipment is used to support flight operations by moving, starting, and loading aircraft. Table 8.1 lists ground support equipment by vessel class (Navy, 2001a). These vehicles contain MIL-DTL-5624T fuel, MIL-H-18282 hydraulic fluid and MIL-PRF-2104G engine oil, MIL-PRF-2105E oil, SAE J2362 oil, Dextron Type II and III automatic transmission fluid, MIL-PRF-83282D hydraulic fluid, MIL-L-17331H hydraulic fluid, MIL-DTL-17111C power transmission fluid, and A-A-52624A anti-freeze. (Navy, 2001a). This equipment contributes hydraulic fluid, anti-freeze, and engine oil to deck runoff through spills and leakage. Although the hydraulic fluid and engine oil are immediately cleaned up, the potential exists for residue to remain on the deck and contribute to deck runoff. Ground support equipment is washed outside of 12 nm, then stored below decks when the ship is within 12 nm. The potential exists for constituents to remain on the deck from the equipment washdown and contribute to deck runoff both inside and outside 12 nm.

JP-8 is used to power various cargo (e.g., Hummvees and tanks) on Army vessels. This cargo may be stored above or below decks. The transfer of JP-8 from on deck systems to cargo is unlikely to occur while on the vessel. However, cargo may occasionally leak trace amounts of JP-8 on to the weather deck (Arredondo, 2001b). Although spills are immediately cleaned up, some fuel may remain trapped in the rough deck surface and has the potential to contribute to deck runoff.

8.1.5 Rotary Wing Aircraft Maintenance and Operations

Rotary wing aircraft operate on medium to large vessels including the AOE 6, CV/CVN, LHD 1, and WHEC Class vessels. Rotary wing operations can be performed both inside and outside of 12 nm, depending on the mission operational area of the vessel. Prior to and upon completion of washdowns, rotary wing aircraft are greased with MIL-PRF-81322F or MIL-PRF-23827C grease to prevent water entry into critical mechanical fittings and linkages. However, this recurring maintenance forces old grease out of the mechanical fittings and linkages, with a portion of this grease possibly falling to the deck. Lubrication of struts and access doors occurs every 7 and 56 days, respectively. This activity contributes to deck runoff through excess grease falling to the

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deck. Rotary wing aircraft also contain hydraulic fluid, MIL-PRF-83282D, which may leak (Navy, 2001a). MIL-PRF-23699F oil is used to lubricate rotary wing engines. This oil may leak to the deck through normal operations. Although the deck is cleaned immediately, some grease and oil remains trapped in the rough deck surface and may contribute to deck runoff both inside and outside 12 nm.

Table 8.1 - Examples of Ground Support Equipment

Equipment Name	Equipment Model Number	Vessel Class		
		AOE 6	CV/CVN	LHD 1
Aircraft Jack	T-3, T-17, T-20	X	X	X
Aircraft Towing Tractor	A/S 32A-31A, A/S 32A-32		X	X
Coolant Oil Servicing Cart	AWG-9		X	
Flight Deck Scrubber	None		X	X
Gas Turbine Engine Enclosure	None		X	X
Hydraulic Power Supply	A/M27T-5, A/M27T-6, A/M27T-7		X	X
Hydraulic Servicing Cart	PMU-55/E	X	X	X
Hydraulic Test Stand	None	X		
Maintenance Stand	B-1, B4		X	X
Mobile Electric Power Plant, Gas Turbine Engine Enclosure	NC-2A		X	X
Nitrogen Oxide Cart	None	X		
Weapons Loading Hoist	HLU-196B/E		X	X

8.2 PERFORMANCE OBJECTIVE: VESSEL, AIRCRAFT, AND VEHICLE REFUELING AND LUBRICATION

The performance objective for vessel, aircraft, and vehicle refueling and lubrication is for the vessel's responsible party to prevent the discharge of anti-freeze compounds, fuels, hydraulic fluids, oils, greases, and other materials associated with vessel, aircraft, and vehicle refueling and lubrication that may negatively impact water quality.

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8.3 ACTIVITIES: VESSEL, AIRCRAFT, AND VEHICLE REFUELING AND LUBRICATION

Examples of activities that could be performed to meet the performance objective of vessel, aircraft, and vehicle refueling and lubrication include:

- Minimizing vessel, aircraft, and vehicle refueling inside 12 nm; and
- Performing hose blowdown or applying back suction to drain the hose.

The feasibility and economic cost of these activities are discussed below.

Although other activities could be included in a vessel's TMP (e.g., avoid over application of lubricants and installing high visibility information placards at fueling stations), this report analyzes only the activities listed above.

8.3.1 Minimizing Vessel, Aircraft, and Vehicle Refueling Inside 12 nm

Vessel Refueling

Depending on the vessel's mission operational area, vessels may be refueled both inside and outside 12 nm. Although decks are immediately cleaned after spills, some fuel may remain trapped in the rough deck surface and contribute to deck runoff both inside and outside 12 nm. If a vessel is refueled outside 12 nm, the amount of constituents on the deck that could contribute to deck runoff inside 12 nm would be reduced because most of any spilled fuel would be cleaned from the deck before the vessel is within 12 nm. Vessels would not specifically transit outside 12 nm to conduct refueling. One action that could be performed, provided it does not impact the vessels mission or operational requirements, is to check and top off fuel tanks prior to expected vessel transit within 12 nm of shore.

Aircraft Refueling

Aircraft are refueled both inside and outside 12 nm depending on the vessel's mission operational area. Although decks are cleaned immediately after spills, some fuel remains trapped in the rough deck surface and contributes to deck runoff. If an aircraft is refueled outside 12 nm, the mass loadings of fuel and other constituents flowing overboard when the vessel is inside 12 nm would be reduced because most of any spilled fuel would be cleaned from the deck before the vessel is within 12 nm. Vessels will not specifically transit outside 12 nm to conduct aircraft refueling. Fixed wing aircraft, found only on Navy vessels, are always refueled outside 12 nm. Rotary wing aircraft can be refueled inside or outside 12 nm depending on the patrol area of the vessel. In general, on Navy vessels, rotary wing aircraft are refueled outside 12 nm. On U.S. Coast Guard vessels, rotary wing aircraft may be fueled inside or outside 12 nm, with the majority of aircraft refueling occurring outside 12 nm. Table 8.2 presents the approximate percentages for refueling location (i.e., inside or outside 12 nm) for U.S. Coast Guard aircraft capable vessels (Navy, 2001c). One action that could be performed, provided it does not impact the aircraft mission or operational requirements, is to check and top off fuel tanks prior to expected vessel transit within 12 nm of shore.

Table 8.2 - U.S. Coast Guard Vessel Class Rotary Wing Aircraft Refueling

Vessel Class	Refueling Inside 12 nm	Refueling Outside 12 nm
WAGB 399	0%	100%
WHEC 378	8%	92%
WMEC 270	7%	93%
WMEC 210	7%	93%

Vehicle Refueling

On Navy vessels, ground support equipment is refueled where the equipment is located (i.e., either above or below decks). Although decks are immediately cleaned after spills, some fuel may remain trapped in the rough deck surface and contribute to deck runoff. Under this activity, vessels would not specifically transit outside 12 nm to conduct vehicle refueling. If a vehicle is refueled outside 12 nm, the amount of constituents on the deck that would subsequently contribute to deck runoff inside 12 nm would be reduced because most fuel would have been cleaned from the deck before the vessel is within 12 nm. The majority of U.S. Army vehicles are not refueled underway. One action that could be performed, provided it does not impact the vehicles' and vessels' mission or operational requirements, is to check and top off fuel tanks prior to expected vessel transit within 12 nm of shore.

The feasibility and cost of this activity are presented below.

8.3.1.1 Personnel Impact

Minimizing vessel, aircraft, and vehicle refueling inside 12 nm is currently performed on Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

8.3.1.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

8.3.1.3 Cost Analysis

Minimizing vessel, aircraft, and vehicle refueling and lubrication inside 12 nm is currently an accepted practice onboard Armed Forces vessels. The only incremental cost associated with this activity is incorporating it into the TMP.

8.3.2 Performing Hose Blowdown or Applying Back Suction to Drain the Hose

A hose blowdown occurs after the refueling is complete and the ship's fuel tank is secured from the aircraft. When performing a hose blowdown, the valve from the tank is closed and the remaining fuel is pumped to the aircraft, emptying all fuel from the hose. Back suction takes place when the fueling is complete; the transfer pump is reversed, and all fuel left in the hose is pumped into the shipboard fuel holding tank. Both of these methods prevent fuel from spilling on the deck, therefore reducing the amount of JP-5 that may contribute to deck runoff through hose disconnect spillage. With the exception of the U.S. Coast Guard, this activity is currently in

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place on Armed Forces vessels that conduct fueling operations. The U.S. Coast Guard uses special self-closing nozzles on its aircraft refueling hoses. This type of nozzle locks into a corresponding receptacle on the aircraft. Different types of aircraft typically have different style refueling receptacles or fill ports. Because U.S. Coast Guard vessels only carry two types of aircraft (HH-65 & HH-60), the use of an aircraft specific self-closing refueling nozzle is possible. The feasibility and cost of this activity are presented below.

8.3.2.1 Personnel Impact

Performing hose blowdown or applying back suction is an accepted practice onboard all Armed Forces vessels. Because this practice is currently in place, additional impacts on personnel are not expected.

8.3.2.2 Other/Unique Characteristics

No unique characteristics have been identified for this activity.

8.3.2.3 Cost Analysis

Performing hose blowdown or applying back suction is an accepted practice on Armed Forces vessels. The only incremental cost associated with this activity is incorporating it into the TMP.

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